Substitute Specification (Marked-up Version)

A METHOD OF RECORDING ONLINE TIME OF A DHCP USER IN A BROADBAND ACCESS SERVER

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FIELD OF THE INVENTION

The present invention generally relates to a method of recording online time of a user in a server in communication technology, and more particularly relates to an improvement of a method of recording online time of a DHCP online user in a broadband access server.

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BACKGROUND OF THE INVENTION

With popularization of data services, there is little requirement of network knowledge for internet users.   Because of its user-friendly interface and no requirement of sophisticated network knowledge for clients, an access mode of DHCP+WEB+RADIUS is becoming a

15   very popular network mode provided by telecom service providers.

DHCP, an abbreviation of Dynamic Host Configuration Protocol, allows a server to dynamically assign an IP address and relevant configuration information of the server to a client.   For such a DHCP, each client can obtain an IP address at start and occupy the IP address thereafter, thus a DHCP access mode uses mass address resources of telecom service

20   providers.   Furthermore, the DHCP access mode is unlike a narrowband access mode that can supply a human-machine interface with a perfect connection and disconnection mechanism.   At present, no fee charging method based on client's online time is available in the market, and only a monthly flat rate is applied for the clients, which may waste a lot of resources.   On the other hand, with concerns on service levels and returns on investment,

25   service providers demand urgently technologies of accurate timing methods to realize the fee charging method based on client's online time for DHCP users.   When a DHCP user has been in an IDLE state for a period of time, that is, when the user's communication data flow

has been lower than an assigned value for a period of time, the user might be considered to be offline, and ~~time recording for~~ charging the user should be stopped.   In other words, it needs to detect a user's IDLE state.   Once the user is detected in the IDLE state, the user's connection with the network should be disconnected, and meanwhile, ~~time recording of~~

5   charging the user for online time should be ceased.   Therefore, login timing accuracy to DHCP users relies on ~~the time~~ timeliness and accuracy of detecting the IDLE state.

Conventional detection methods of the IDLE state are in such a way that a timer is directly configured such that data flow of a user is detected periodically at each interval so as to decide whether an increment between the user's data flow and the last check point is less

10   than a threshold (assigned value); if the increment is not greater than the threshold, the user is considered offline; otherwise, the user is considered online or downloading.

The conventional technology, however, has the following defects:

1. Due to inaccuracy of fee charging methods, a user in an IDLE state may be considered as in a normal online state.

15   For example, as shown in FIG. 1A, provided that a time interval for IDLE detection is about 5 minutes, a user has a great deal flow at the first minute, and the flow does not exceed a threshold, the user will be forced to login off at the tenth minute according to a conventional algorithm.   Such detection error is certainly too large, and can also make a waste in communication resources.   To solve the problem, the time interval of detection is usually

20   reduced in conventional methods for IDLE state detection.

2. Due to fixed time intervals, the state of a user may wrongly be detected.

For example, as shown in FIG. 1B, if the user's flow is relatively large at the fourth and the sixth minute, but such a flow is not large enough to exceed the threshold, the user will be forced to logoff at the tenth minute.   In fact, the user's flow at an interval of five minutes

25   exceeds the threshold, and therefore the state of the user may wrongly be detected.   To solve the problem, testing time is usually increased in conventional methods for IDLE state detection so as to reduce frequency of wrong detection.   Thus it is difficult for conventional

methods to achieve a desirable precision for time charging to DHCP users.

Therefore, a heretofore unaddressed need exists in the art to address the aforementioned deficiencies and inadequacies.

5   **SUMMARY OF THE INVENTION**

The technical problem solved in the present invention is to provide a method of recording the online time of a DHCP user in a broadband access server, which reduces detection error, solves the problem in detecting IDLE state and satisfies the accuracy required.

In one aspect, the present invention relates to a method of recording the ~~amount of~~

10   online time of a DHCP user in a broadband access server.   The broadband access server detects a data flow of an authenticated user by using an inner time interval that is shorter than an outer time interval and a flow threshold and establishing a circular linked list corresponding to the user, and deciding whether the user is in an IDLE state; if not, the broadband access server records the present flow value in the circular link list and continually

15   detects the data flow of the user; otherwise the broadband access server determines the user to be in the IDLE state.   By reducing the time unit for the data flow detection, the detection error is reduced, the problem of detecting an IDLE state is solved, and the required precision is satisfied.

In one embodiment, the method comprises the following steps:

20   (a)   setting an inner time interval for monitoring a data flow of the user in the broadband access server, an outer time interval for detecting an IDLE state outside the broadband access server and a flow threshold for counting the data flow of the user in the broadband access server, and the inner time interval being shorter than the outer time interval;

(b)   <u>authenticating the user trying to access to the broadband access server, and</u>

25   <u>informing a charging server in communication with the broadband access server to start</u>

<u>charging the user if the user is successfully authenticated.</u> ~~providing a fee calculation server in~~

~~communication with the broadband access server for recording the amount of online time of the~~

~~user and starting recording the online time of the user by the fee calculation service when receiving an instruction of the broadband access server after the user accesses the broadband access server and is authenticated successfully;~~

(c)   establishing in the broadband access server a circular link list having a number of elements to the user for recording the data flow of the user, wherein the element number of the circular link list is the number of times of the outer time interval to the inner time interval; and

(d)   repeatedly detecting the data flow of the user in the broadband access server at each inner time interval, and recording the detected data flow as a content of a head pointer of the circular link list in turn, until a difference between the newly detected data flow and the content recorded in the head pointer is not more than the flow threshold.

The method also includes the steps of deciding the user in the IDLE state in the broadband access server when the difference between the newly detected data flow and the content recorded in the head pointer is less than the flow threshold, and stopping recording the online time of the user by the fee calculation service according to an instruction of the broadband access server.

In one embodiment, the method further comprises the steps of: comparing the current element number of the circular link list with the target element number of the circular link list, if the current element number of the circular link list is less than the target element number of the circular link list, then saving the newly detected data flow as the content of a head pointer of the circular link list, adding an element to each inner time interval and pointing a tail pointer of the circular link list to the newly added element. In one embodiment, the method further comprises the steps of: comparing the difference between the newly detected data flow and the content recorded in the head pointer with the flow threshold, if the difference between the newly detected data flow and the content of the head pointer exceeds the flow threshold, then moving the head pointer and the tail pointer down one position in the circular link list, and saving the newly detected data flow as the content of the tail pointer, otherwise, deciding

the user is in the IDLE state. ~~when the circular link list is not fully filled, step (d) further comprises the step of saving the newly detected data flow as the content of the head pointer, and moving the head and tail pointers down a position in the circular link list. When the circular link list is full, step e) further comprises the step of examining the newly detected~~

5   ~~data flow and the content of the head pointer element, when the difference~~ between ~~the newly detected data flow and the content of the head pointer exceeds the flow threshold, moving the head and tail pointers down a position in the circular link list, and saving the newly detected data flow as the content of the head pointer~~.

In one embodiment, the inner time interval is about 30 seconds and/or the outer time

10   interval is about 5 minutes.

In one embodiment, the broadband access server defines a circular link list corresponding to a login user, regarding each element in the circular link list, the content of the head pointer records a data flow that is detected in turn and when the assigned threshold is exceeded, and the tail pointer is pointed to the next element of the circular link list, so that the

15   data flow of the user can be monitored dynamically.   In such a way, the detection precision of the online time of the user is based on the inner time interval, which is much less than the outer time interval.   Therefore, the detection precision is improved and the detection error is reduced.

The technical solution and its advantage effects of the present invention will be

20   obvious through describing of the preferred embodiments of the present invention in details below in combination with drawings attached.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A and 1B are schematic diagrams of the data flow detection of a conventional

25   method.

FIG. 2 shows a flow chart of a method of recording ~~an amount of~~ online time of a user in a broadband access server according to one embodiment of the present invention.

FIG. 3 is a flow chart of detection for each inner detection period utilized in the method shown in FIG. 2.

FIG. 4 is a schematic diagram of data structure utilized in the method shown in FIG. 2.

5   **DETAILED DESCRIPTION OF THE INVENTION**

A method of recording ~~an amount of~~ online time of ~~a~~ the user in a broadband access server according to one embodiment of the present invention comprises the following steps:

Firstly, an outer time interval and an inner time interval are configured in a broadband access server for detecting an IDLE state, which corresponds to a logout state or offline of a

10   user. In general, the broadband access server monitors user's data flow in all time, where a unit of an interval (inner time interval) for monitoring the user's data flow in the broadband server is in seconds, and a unit of an interval (outer time interval) for detecting an IDLE state at outside of the broadband access server is in minutes. According to one embodiment of the present invention, the inner time interval for monitoring the user flow must be smaller than

15   the outer time interval for the IDLE state detection outside. For example, an outer detection time may be set to be about 5 minutes; a threshold is about 10k, a time interval for detecting the user flow within the system, namely inner time interval, is about 30 seconds. Referring to FIG. 2, the ~~time~~ method of recording ~~method~~ the online time for the DHCP user is further described as below.

20   At step 110: a user automatically obtains an IP address by the DHCP, is authenticated successfully, and then accesses the Internet; and the broadband access server timely informs a ~~fee calculation~~ charging server to start recording the online time of the user.

At step 120: ~~the time~~ recording the online time of the user starts from the time when the user is authenticated successfully. In general, passing through authentication for the user

25   indicates that the user starts to accept the service provided by the service provider.

At step 130: the broadband access server calculates a number of elements in a circular link list based on the inner time interval and the outer time interval. The number of elements

equals to the ratio of the outer time interval to the inner time interval.   For example, in one

embodiment, the outer time interval is set to be about 5 minutes and the inner time interval is

set to be about 0.5 minutes.   Accordingly, the number of elements of the circular link list is

equal to ~~the ratio of 5 to 0.5~~ a result of dividing the outer time interval by the inner time

5   interval, that is, about 10.   The broadband access server then records the calculated result.

At step 140: the information on the user flow is ~~timely~~ periodically updated in the

circular link list.

At step 150: an IDLE state of the user is detected.

At step 160: the user in the IDLE state is forced to log out.

10   Referring to FIG. 3, the flow chart of detection for the circular link list is shown

according to one embodiment of the present invention.   The circular link list corresponds to

an accessed and authenticated user.   In a process of recording a corresponding user's data

flow, a pointer is used to point a head pointer of the circular link list.   The content of an

element of the head pointer is corresponding to the value of the data flow before an IDLE

15   detection interval, and the content of an element pointed by a tail pointer is the latest detected

data flow result.

The user's circular link list is not fully filled at the time when the user just passes the

authentication.   At first, whether the number of elements filled in the circular link list is up

to 10, or not, is checked.   If the number of filled elements is not up to 10, an element is

20   added at each interval of the inner time interval, the content of the head pointer is filled with

the detected data flow result, the element newly added is added to the tail of the circular link

list, and the tail pointer points to the newly added element accordingly.   Particularly, each

newly detected value of the data flow is compared with the content of the head pointer in the

circular link list.   After compared, if the user is not in an IDLE state, such newly detected

25   data flow value is saved in the content of the head pointer.   At the same time, the head and

tail pointers move down one position in the circular link list, so as to ensure that the content

of the element of the head pointer still is the value of the data flow immediately before one

IDLE detecting interval and the content of the element pointed by the tail pointer still is the latest detected data flow result.

If the circular link list is fully filled (up to 10), newly detected data flow value is compared with the value of the element of the head pointer. If the difference between the newly detected data flow and the content of the element of the head pointer is greater than the assigned threshold, for example, 10k, the newly detected data flow value overwrites the value of the head pointer. Meanwhile, the head and tail pointers are moved down one position, so as to ensure that the value of the element of the head pointer still is the data flow value immediately before one IDLE detecting interval and the value of the element pointed by the tail pointer still is newly detected data flow result.

If the difference between the newly detected data flow and the content of the element of the head pointer is not greater than the assigned threshold, e.g., 10k, the user is considered being offline; and then the broadband access server sets the user in unauthenticated state, that is, the user is forced to logout. Meanwhile, the broadband access server informs RADIUS Server (a fee calculation charging server) of the user being offline and stopping time recording. charing. The time when the user logs out is considered as the time 5 minutes before.

In the embodiment, as shown in FIGS. 2 and 3, the broadband access server starts to query the user's data flow. As shown in FIG. 3, the flow detection for the circular link list includes the following steps: at step 300, the number of elements in a corresponding circular link list is obtained by detecting the user's data flow. At step 310, the number of elements is compared with those in the current circular link list. Then, at step 320, whether a desirable number of elements is achieved is determined. If not, the detection result is filled to the content of the head pointer. Meanwhile, the tail pointer is pointed to the newly detected element. The head and tail pointers are then moved down one position in the circular link list, and the data flow is detected for a next inner time interval at step 340. If the number of elements in the circular link list is greater than the desirable number, the element of the tail

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pointer and the content of the head pointer are compared at step 330. Then whether the difference between the element of the tail pointer and the content of the head pointer is greater than the assigned threshold is determined at step 350. If the difference is greater than the assigned threshold, the head and tail pointers are moved down one position in the circular link

5   list, and the new data flow is filled to the content of the head pointer at step 360. If the difference is not greater than the assigned threshold, the user is set to be in unauthenticated state and forced to offline by the broadband access server at step 370. Then the system is returned to its detection state at step 380.

In one embodiment of the present invention, the detected results of the data flow of the

10   user in the latest period of time are saved in turn, which corresponds to a queue of the user's flow data observing through a data window in which the width of the data window is width of the inner time interval for detecting flow assigned for the user. In the data window, multiple detecting results are saved, and the interval of each result is corresponding to the inner time interval for detecting flow in the system, as shown is FIG. 4.

15   According to the present invention, when the data flow of the user is queried once, the data window goes forward one position. While moving, the data flow results at the two ends of the window are compared; if the difference between the flow results at the two ends of the window is not greater than the threshold, the user is considered in an IDLE state and forced to be offline. Otherwise, the newly detected data is filled into the content of the head pointer.

20   Generally, in the conventional algorithms for realizing the IDLE detection, the granularity of detection is a time interval assigned for detecting, such as 5 minutes. However, according to the method (algorithm) of the present invention, the detection granularity is the inner time interval for querying user's data flow in the broadband access server, such as 30 seconds, so the detection is more accurate.

25   It should be noted that the inner time and the outer time in the method of the present invention could be assigned in different values. The specific value mentioned above is corresponding to one embodiment of the present invention, which should not be used to limit

the scope of the present invention.

It should be noted that, persons skilled in the art should understand that, the technical solutions of the present invention can be modified or substituted, without departing from the spirit and scope of the present invention, and all the modification and substitution fall in the scope of claims in the present invention.

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ABSTRACT

A method of calculating online time of a DHCP user in a broadband access server includes the steps of: (a) setting an inner time interval for monitoring a data flow of the user in the broadband access server, an outer time interval for detecting an IDLE state outside the

5   broadband access server and a flow threshold for counting the data flow of the user in the broadband access server, and the inner time interval being shorter than the outer time interval; (b) providing a fee calculation server in communication with the broadband access server for recording the amount of online time of the user and starting recording the online time of the user by the fee calculation service when receiving an instruction of the broadband access

10   server after the user accesses the broadband access server and is authenticated successfully; (c) establishing in the broadband access server a circular link list having a number of elements to the user for recording the data flow of the user, wherein the element number of the circular link list is the number of times of the outer time interval to the inner time interval; and (d) repeatedly detecting the data flow of the user in the broadband access server at each inner

15   time interval, and recording the detected data flow as a content of a head pointer of the circular link list in turn, until a difference between the newly detected data flow and the content recorded in the head pointer is not more than the flow threshold.